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(71)出願人 000005108

株式会社日立製作所

東京都千代田区神田駿河台四丁目6番地

(72)発明者 高島 勝

茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

(72)発明者 長江 慶治

茨城県日立市久慈町4026番地 株式会社日立製作所日立研究所内

(74)代理人 弁理士 小川 勝男

(54)【発明の名称】 TFT-LCDの製造方法

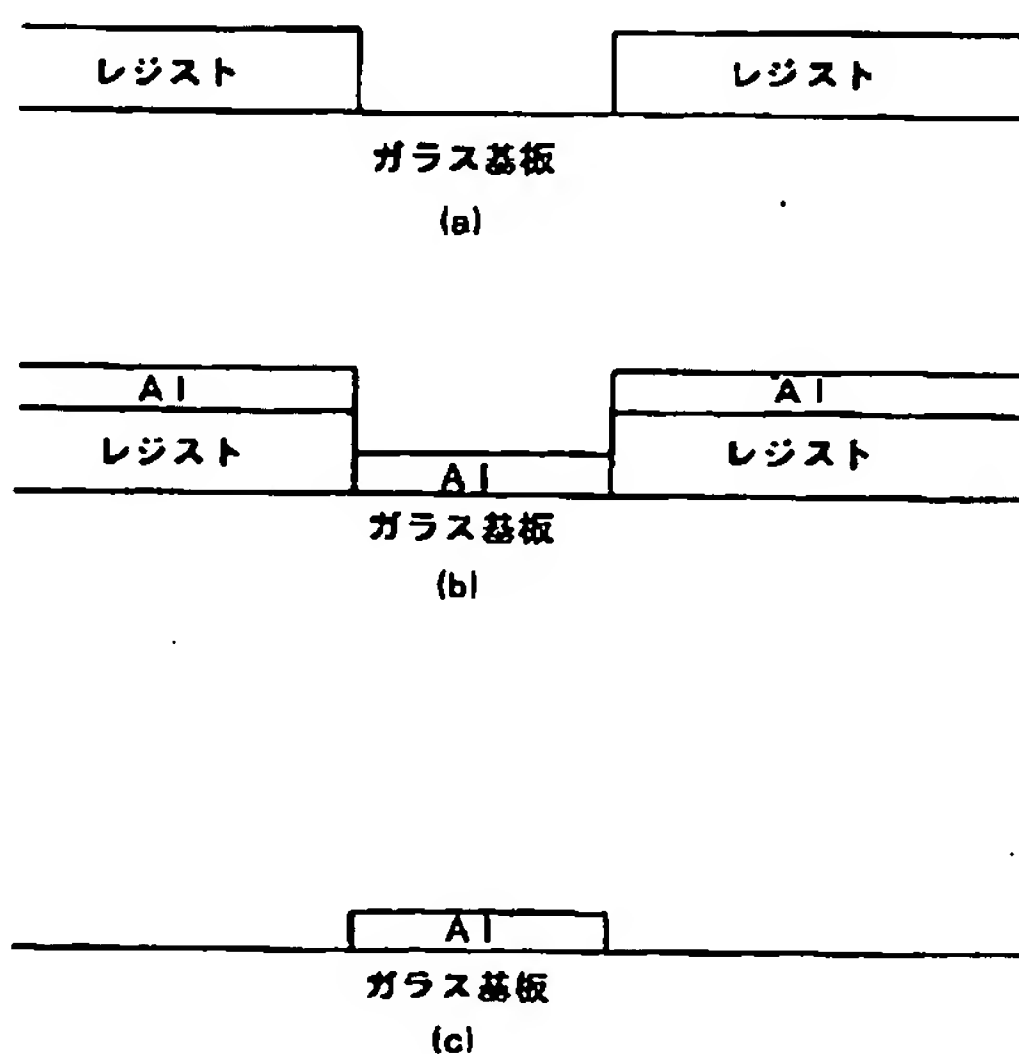
(57)【要約】

【目的】TFT-LCDにおいて、TFT-LCDの製造工程短縮を行い、低コスト、高信頼性のTFT-LCDを提供することである。

【構成】スパッタ装置で形成する電極材料は反転マスクのレジストが形成されているガラス基板上に堆積され、その後リフトオフ法でパターニングする。

【効果】上記製造方法では、スパッタ装置で形成する電極材料はリフトオフ法でパターニングされるため、金属のエッチング工程はなくなり、また、ホトレジストは金属のエッチング液にさらされないため、ホトレジストの剥離は容易になる。以上により、TFTの製造工程数は短縮されるので、低コスト、高信頼性のTFT-LCDを提供することができる。

図 1



## 【特許請求の範囲】

【請求項1】 TFT-LCD (Thin Film Transistor - Liquid Crystal Display)の製造方法において、スパッタ装置で形成する電極材料は反転マスクのレジストが形成されているガラス基板上に堆積され、その後リフトオフ法でパターニングされることを特徴とする TFT-LCDの製造方法。

【請求項2】 TFT-LCDの製造ラインにおいて、スパッタ装置の前段にレジストの露光、現像を行う装置が挿入されていることを特徴とする TFT-LCDの製造設備。

【請求項3】 請求項1記載の製造方法を用いて形成した TFTのデバイス構造において、画素電極はドレイン/ソース電極よりも下層にあることを特徴とする TFTのデバイス構造。

【請求項4】 請求項1記載の反転マスクのレジストは印刷法で形成することを特徴とする TFT-LCDの製造方法。

【請求項5】 TFT-LCDの製造ラインにおいて、スパッタ装置の前段にレジスト印刷を行う装置が挿入されていることを特徴とする TFT-LCDの製造設備。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は液晶表示装置に係り、特に TFT-LCDの製造工程短縮に関するものである。

## 【0002】

【従来の技術】 従来、TFT-LCD (Thin Film Transistor - Liquid Crystal Display)の製造方法に関しては、例えば日経エレクトロニクス、日経マイクロデバイス編、『フラットパネルディスプレイ '91』に記載されているように、LSIの製造方法と同様な手法を用いている。図5は従来の TFTの製造工程を示したものである。

## 【0003】

【発明が解決しようとする課題】 上記した従来技術は、次のような問題点を有していた。

【0004】 すなわち、上記製造方法では金属のエッチング回数は3回、半導体膜と絶縁膜のエッチング回数は5回必要となり、製造工程が長くなる。また、エッチング後のホトレジストの除去は比較的困難となるのでスループットは低くなる。

【0005】 本発明の目的は、以上に述べた問題点を解決し、低コスト、高信頼性の TFT-LCDを提供することである。

## 【0006】

【課題を解決するための手段】 前記の問題点を解決するために、本発明はスパッタ装置で形成する電極材料は反転マスクのレジストが形成されているガラス基板上に堆積され、その後リフトオフ法でパターニングする工程を有する TFT-LCDの製造方法を提案するものであ

る。

## 【0007】

【作用】 上記した製造方法では、金属のエッチング工程はなくなるので、その分、TFTの製造工程は短くなる。また、リフトオフ法で電極をパターニングするため、ホトレジストは金属のエッチング液にさらされない。したがって、ホトレジストの剥離は容易になる。よって、低コスト、高信頼性の TFT-LCDを提供することができる。

## 【0008】

【実施例】 以下に図面を参照して本発明を詳細に説明する。

【0009】 図1は本発明によるゲート電極の製造方法の実施例である。製造手法としては図中に示すように、

(a) ガラス基板上にゲート電極の反転マスクを用いてレジストをパターニングする、(b) 次に、ゲート電極となる Al をスパッタリングし、(c) 次に、レジスト剥離を行いゲート電極を形成する。ここで、スパッタリング法は CVD 法 (Chemical Vapor Deposition Method) と異なり、膜の堆積の指向性が高いためリフトオフ法に適している。上記した製造方法では、ゲート電極のエッチング工程はなくなるので、その分、TFTの製造工程は短くなる。また、リフトオフ法でゲート電極をパターニングするため、ホトレジストはゲート電極のエッチング液にさらされない。したがって、ホトレジストの剥離は容易になる。

【0010】 図2は本発明による画素電極の製造方法の実施例である。製造手法としては図中に示すように、

(a) a-Si、あるいは SiN 膜上に画素電極の反転マスクを用いてレジストをパターニングする、(b) 次に、画素電極となる ITO をスパッタリングし、(c) 次に、レジスト剥離を行い画素電極を形成する。上記した製造方法では、画素電極のエッチング工程はなくなるので、その分、TFTの製造工程は短くなる。また、リフトオフ法で画素電極をパターニングするため、ホトレジストは画素電極のエッチング液にさらされない。したがって、ホトレジストの剥離は容易になる。

【0011】 図3は本発明によるドレイン/ソース電極の製造方法の実施例である。製造手法としては図中に示すように、(a) a-Si、ITO あるいは SiN 膜上にドレイン/ソース電極の反転マスクを用いてレジストをパターニングする、(b) 次に、ドレイン/ソース電極となる Cr をスパッタリングし、(c) 次に、レジスト剥離を行いドレイン/ソース電極を形成する。上記した製造方法では、ドレイン/ソース電極のエッチング工程はなくなるので、その分、TFTの製造工程は短くなる。また、リフトオフ法でドレイン/ソース電極をパターニングするため、ホトレジストはドレイン/ソース電極のエッチング液にさらされない。したがって、ホトレジストの剥離は容易になる。

【0012】また、本発明を用いた場合、電極のテーパエッチングはできない。したがって、断線防止のために、画素電極となるITOは、図中に示すように、ドレイン/ソース電極よりも下層になければならない。

【0013】図4は本発明によるTFT-LCD製造ラインの一部分の構成を示したものである。本発明ではスパッタ装置で形成する電極材料をリフトオフ法によりパターニングするため、図中に示すように、電極形成用スパッタ装置の後段にはレジスト剥離装置が、電極形成用スパッタ装置の前段にはレジスト露光・現像装置、あるいはレジスト印刷装置が設置される。特に、ホトリソグラフィ工程を用いないレジスト印刷装置を使用することは、TFT製造のスループットを大幅に向上させる。

【0014】

【発明の効果】以上の説明から明かなように、本発明によれば、スパッタ装置で形成する電極材料はリフトオフ法でパターニングされるため、金属のエッチング工程はなくなり、また、ホトレジストは金属のエッチング液

にさらされないで、ホトレジストの剥離は容易になる。以上により、TFTの製造工程数は短縮されるので、低コスト、高信頼性のTFT-LCDを提供することができる。

【図面の簡単な説明】

【図1】本発明によるゲート電極の製造方法の実施例を示す図である。

【図2】本発明による画素電極の製造方法の実施例を示す図である。

10 【図3】本発明によるドレイン/ソース電極の製造方法の実施例を示す図である。

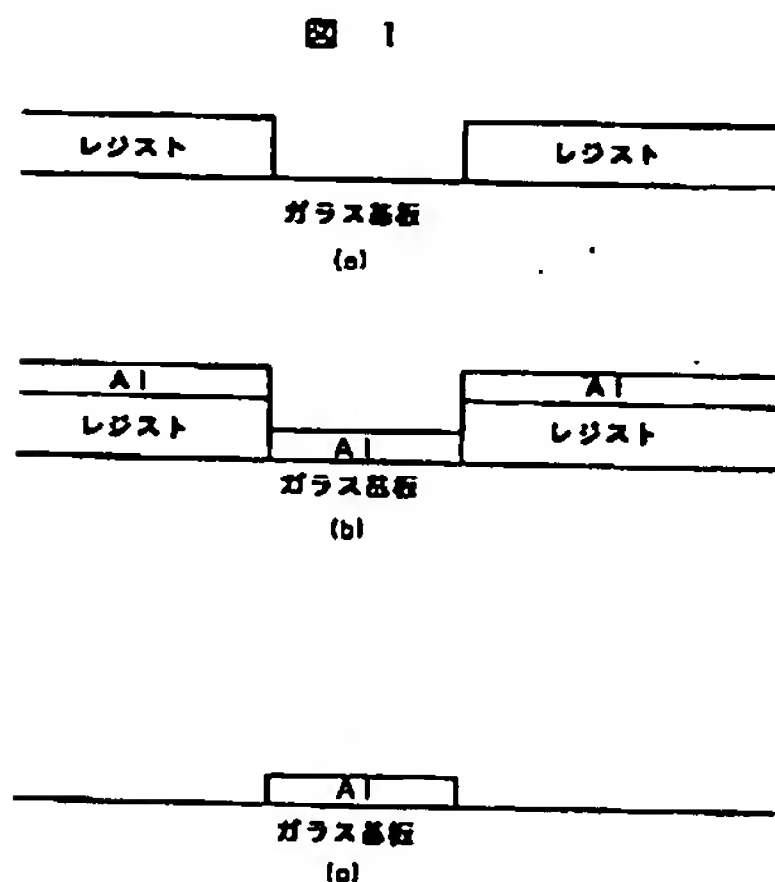
【図4】本発明によるTFT-LCD製造ラインの一部分の構成図である。

【図5】従来のTFTの製造工程図である。

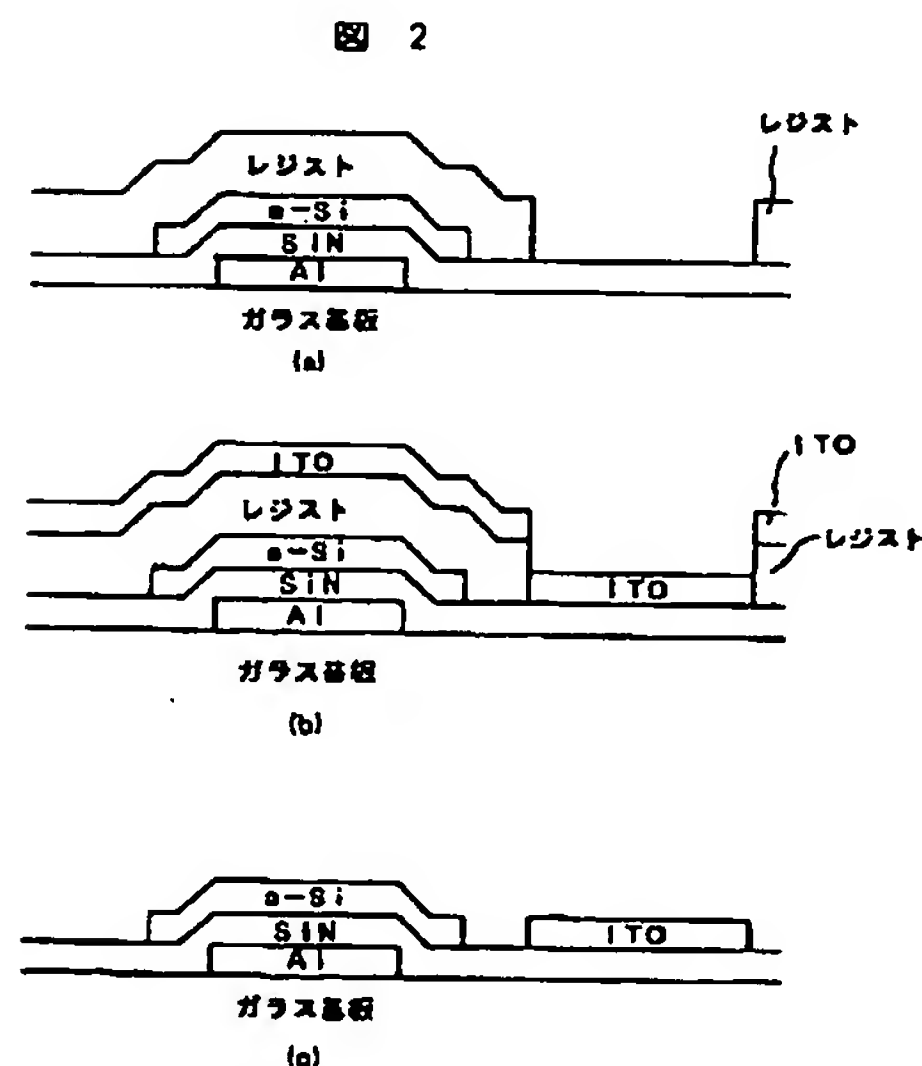
【符号の説明】

Al…アルミニウム、SiN…窒化シリコン膜、a-Si…アモルファスシリコン、ITO…インジウム・ティン・オキサイド（透明導電膜）、Cr…クロム。

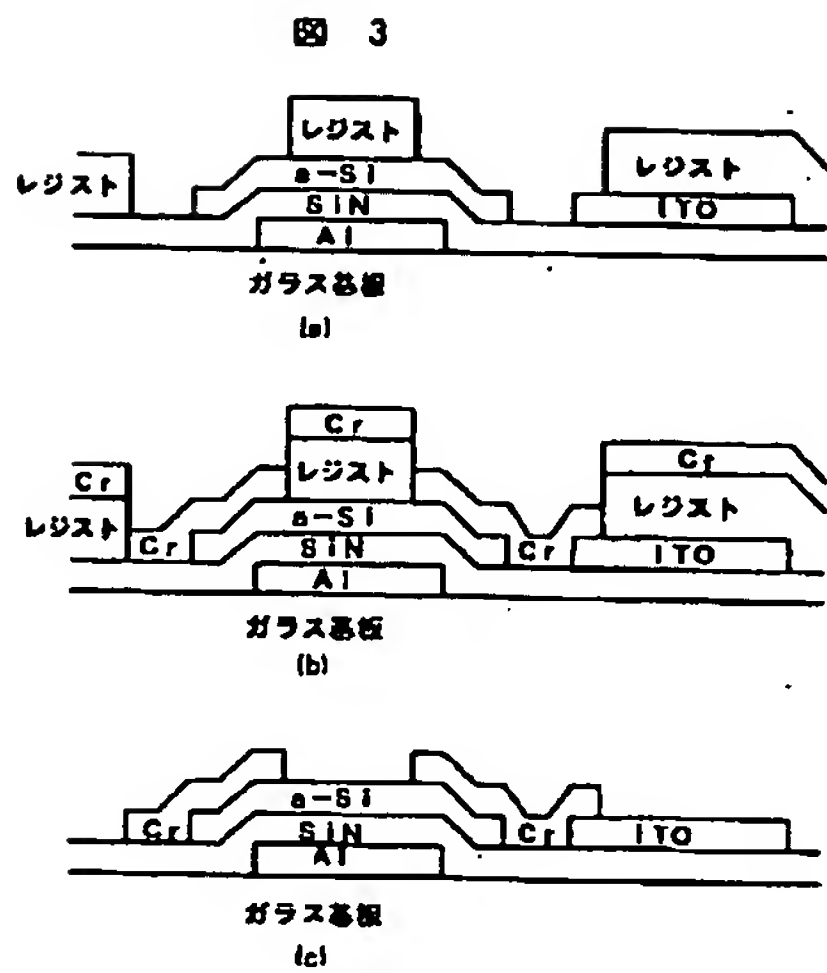
【図1】



【図2】

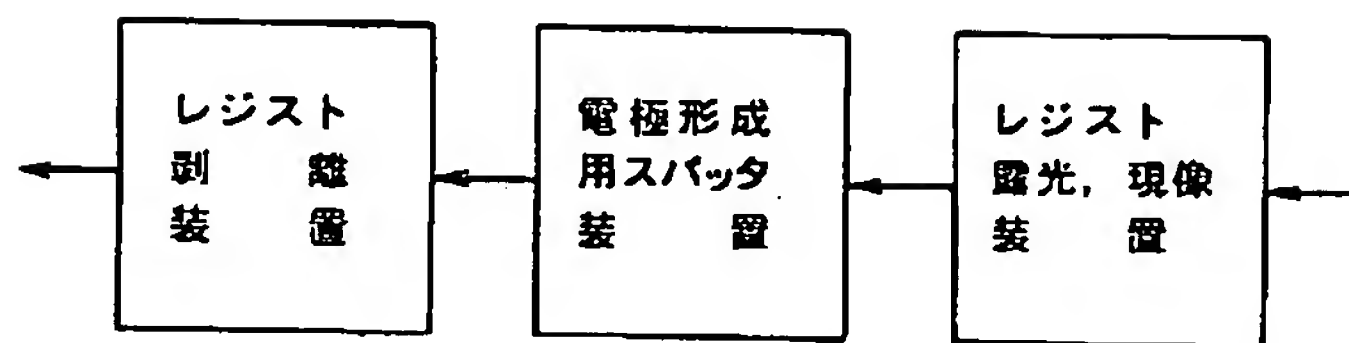


【図3】

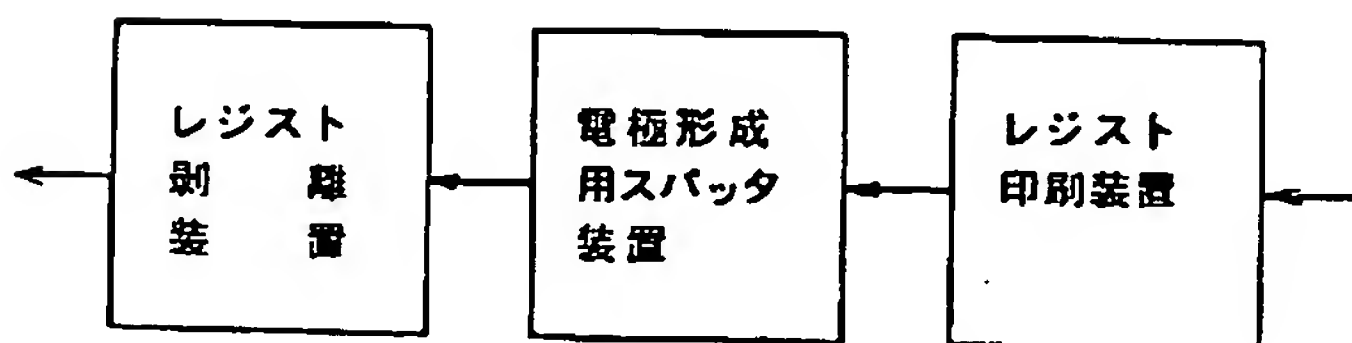


【図4】

図 4



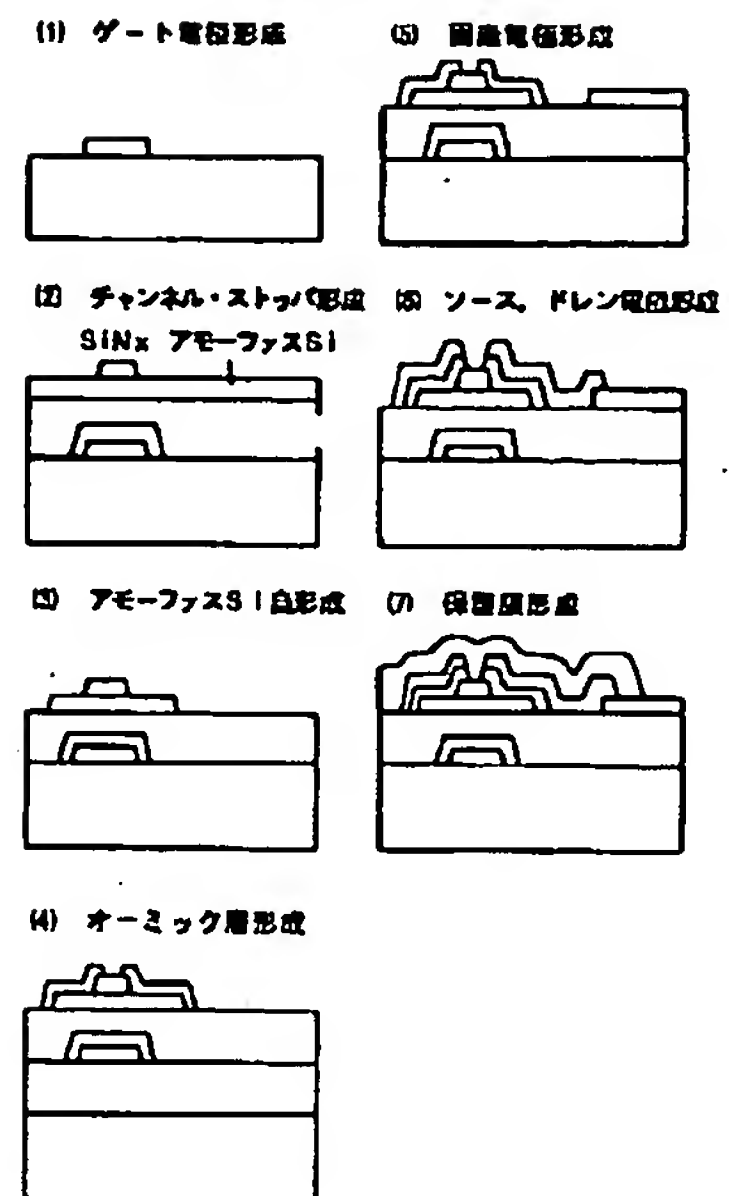
(a) 実施例その1



(b) 実施例その2

【図5】

図 5



フロントページの続き

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H01L 21/336

29/784

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## PATENT ABSTRACTS OF JAPAN

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H01L 27/12  
H01L 29/40  
H01L 21/336  
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(21)Application number : 04-053258

(71)Applicant : HITACHI LTD

(22)Date of filing : 12.03.1992

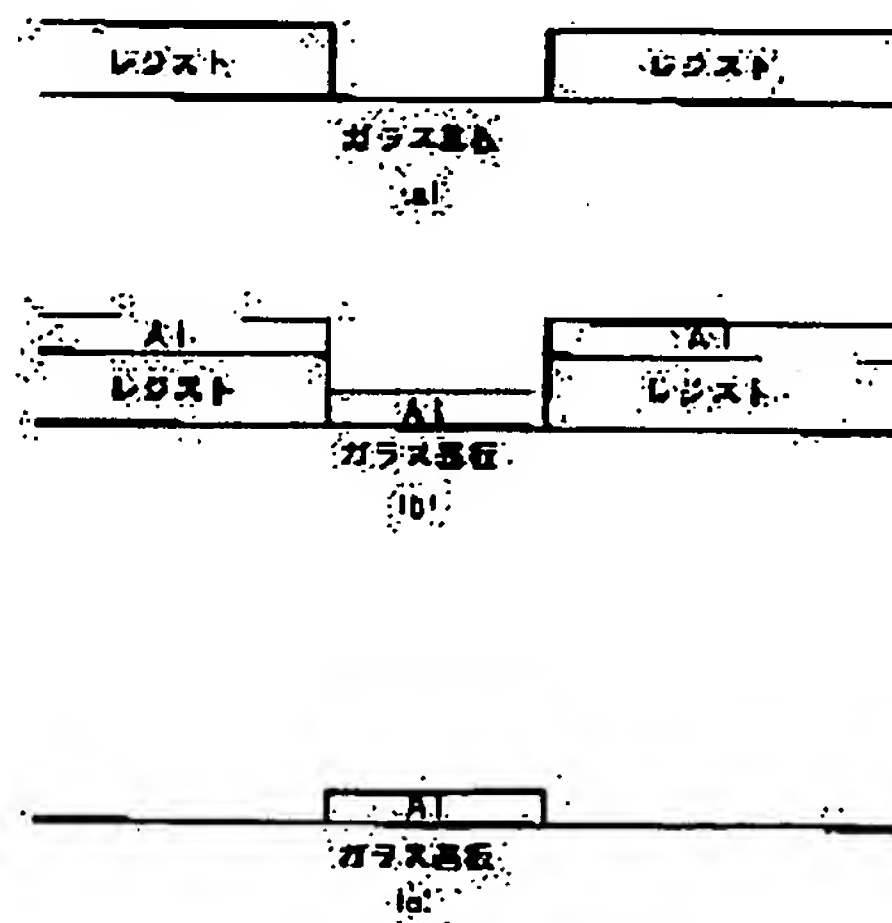
(72)Inventor : TAKAHATA MASARU  
NAGAE KEIJI

## (54) PRODUCTION OF TFT-LCD

## (57)Abstract:

PURPOSE: To provide the low-cost TFT-LCD having high reliability by shortening the process for production of the TFT-LCD.

CONSTITUTION: An electrode material formed by a sputtering device is deposited on a glass substrate formed with the resist of a reversal mask and is thereafter patterned by a lift-off method. Then, the electrode material formed by the sputtering device is patterned by the lift-off method in this process for production and, therefore, a stage for etching metals is eliminated and since the photoresist is not subjected to an etching liquid for the metals, the peeling of the photoresist is easy. The number of steps of the production process for the TFTs is thereby shortened and, therefore, the low-cost TFT-LCD having the high reliability is obtd.



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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**CLAIMS**

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[Claim(s)]

[Claim 1] The electrode material formed with a sputtering system in the manufacture approach of TFT-LCD (Thin Film Transistor-Liquid Crystal Display) is the manufacture approach of TFT-LCD characterized by depositing on the glass substrate with which the resist of a reversal mask is formed, and carrying out patterning by the lift-off method after that.

[Claim 2] The manufacturing facility of TFT-LCD characterized by inserting in the preceding paragraph of a sputtering system the equipment which performs exposure of a resist, and development in the production line of TFT-LCD.

[Claim 3] It is the device structure of TFT characterized by a pixel electrode being in a lower layer rather than a drain / source electrode in the device structure of TFT formed using the manufacture approach according to claim 1.

[Claim 4] The resist of a reversal mask according to claim 1 is the manufacture approach of TFT-LCD characterized by forming by print processes.

[Claim 5] The manufacturing facility of TFT-LCD characterized by inserting the equipment which performs resist printing in the preceding paragraph of a sputtering system in the production line of TFT-LCD.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to a liquid crystal display, especially relates to production process compaction of TFT-LCD.

[0002]

[Description of the Prior Art] Conventionally, about the manufacture approach of TFT-LCD (Thin Film Transistor-Liquid Crystal Display), the manufacture approach of LSI and the same technique are used as described the volume Nikkei electronics and on Nikkei micro device, and "flat-panel display'91", for example. Drawing 5 shows the production process of the conventional TFT.

[0003]

[Problem(s) to be Solved by the Invention] The above-mentioned conventional technique had the following troubles.

[0004] That is, by the above-mentioned manufacture approach, the metaled count of etching is [ the count of etching of the semi-conductor film and an insulator layer ] needed 5 times. 3 times, and a production process becomes long. Moreover, since clearance of the photoresist after etching becomes comparatively difficult, a throughput becomes low.

[0005] The object of this invention is solving the trouble stated above and offering TFT-LCD of low cost and high-reliability.

[0006]

[Means for Solving the Problem] In order to solve the aforementioned trouble, the manufacture approach of TFT-LCD which has the process which deposits the electrode material which forms this invention with a sputtering system on the glass substrate with which the resist of a reversal mask is formed, and carries out patterning by the lift-off method after that is proposed.

[0007]

[Function] By the above-mentioned manufacture approach, since a metaled etching process is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of the electrode by the lift-off method, a photoresist is not exposed to a metaled etching reagent. Therefore, exfoliation of a photoresist becomes easy. Therefore, TFT-LCD of low cost and high-reliability can be offered.

[0008]

[Example] With reference to a drawing, this invention is explained below at a detail.

[0009] Drawing 1 is the example of the manufacture approach of the gate electrode by this invention. As shown all over drawing as the manufacture technique, on the (a) glass substrate, sputtering of the aluminum used as (b), next the gate electrode which use the reversal mask of a gate electrode and carry out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a gate electrode is formed. Here, unlike the CVD method (Chemical Vapor Deposition Method), since the directivity of membranous deposition is high, the sputtering method is suitable for the lift-off method. By the above-mentioned manufacture approach, since the etching process of a gate electrode is lost, the part and the



production process of TFT become short. Moreover, in order to carry out patterning of the gate electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a gate electrode. Therefore, exfoliation of a photoresist becomes easy.

[0010] Drawing 2 is the example of the manufacture approach of the pixel electrode by this invention. As shown all over drawing as the manufacture technique, on (a) a-Si or an SiN film, sputtering of the ITO used as (b), next the pixel electrode which use the reversal mask of a pixel electrode and carry out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a pixel electrode is formed. By the above-mentioned manufacture approach, since the etching process of a pixel electrode is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of the pixel electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a pixel electrode. Therefore, exfoliation of a photoresist becomes easy.

[0011] Drawing 3 is the example of the manufacture approach of of the drain / source electrode by this invention. As shown all over drawing as the manufacture technique, on (a) a-Si, ITO, or an SiN film, sputtering of the Cr used as (b), next the drain / source electrode which uses the reversal mask of a drain / source electrode, and carries out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a drain / source electrode is formed. By the above-mentioned manufacture approach, since the etching process of a drain / source electrode is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of a drain / the source electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a drain / source electrode. Therefore, exfoliation of a photoresist becomes easy.

[0012] Moreover, when this invention is used, taper etching of an electrode cannot be performed. Therefore, there must be ITO which serves as a pixel electrode for open-circuit prevention in a lower layer rather than a drain / source electrode, as shown all over drawing.

[0013] Drawing 4 shows the configuration of a part of TFT-LCD production line by this invention. In this invention, in order to carry out patterning of the electrode material formed with a sputtering system by the lift-off method, as shown all over drawing, resist exfoliation equipment is installed in the latter part of the sputtering system for electrode formation, and resist exposure and a developer, or a resist airline printer is installed in the preceding paragraph of the sputtering system for electrode formation. Especially the thing for which the resist airline printer which does not use a photolithography processes is used raises the throughput of TFT manufacture substantially.

[0014]

[Effect of the Invention] Since patterning of the electrode material formed with a sputtering system is carried out by the lift-off method according to this invention so that clearly from the above explanation, a metaled etching process is lost and a photoresist is not exposed to a metaled etching reagent, exfoliation of a photoresist becomes easy. By the above, since the number of production processes of TFT is shortened, TFT-LCD of low cost and high-reliability can be offered.

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TECHNICAL FIELD

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[Industrial Application] This invention relates to a liquid crystal display, especially relates to production process compaction of TFT-LCD.

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EXAMPLE

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[Example] With reference to a drawing, this invention is explained below at a detail.

[0009] Drawing 1 is the example of the manufacture approach of the gate electrode by this invention. As shown all over drawing as the manufacture technique, on the (a) glass substrate, sputtering of the aluminum used as (b), next the gate electrode which use the reversal mask of a gate electrode and carry out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a gate electrode is formed. Here, unlike the CVD method (Chemical Vapor Deposition Method), since the directivity of membranous deposition is high, the sputtering method is suitable for the lift-off method. By the above-mentioned manufacture approach, since the etching process of a gate electrode is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of the gate electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a gate electrode. Therefore, exfoliation of a photoresist becomes easy.

[0010] Drawing 2 is the example of the manufacture approach of the pixel electrode by this invention. As shown all over drawing as the manufacture technique, on (a) a-Si or an SiN film, sputtering of the ITO used as (b), next the pixel electrode which use the reversal mask of a pixel electrode and carry out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a pixel electrode is formed. By the above-mentioned manufacture approach, since the etching process of a pixel electrode is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of the pixel electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a pixel electrode. Therefore, exfoliation of a photoresist becomes easy.

[0011] Drawing 3 is the example of the manufacture approach of of the drain / source electrode by this invention. As shown all over drawing as the manufacture technique, on (a) a-Si, ITO, or an SiN film, sputtering of the Cr used as (b), next the drain / source electrode which uses the reversal mask of a drain / source electrode, and carries out patterning of the resist is carried out, (c), next resist exfoliation are performed, and a drain / source electrode is formed. By the above-mentioned manufacture approach, since the etching process of a drain / source electrode is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of a drain / the source electrode by the lift-off method, a photoresist is not exposed to the etching reagent of a drain / source electrode. Therefore, exfoliation of a photoresist becomes easy.

[0012] Moreover, when this invention is used, taper etching of an electrode cannot be performed. Therefore, there must be ITO which serves as a pixel electrode for open-circuit prevention in a lower layer rather than a drain / source electrode, as shown all over drawing.

[0013] Drawing 4 shows the configuration of a part of TFT-LCD production line by this invention. In this invention, in order to carry out patterning of the electrode material formed with a sputtering system by the lift-off method, as shown all over drawing, resist exfoliation equipment is installed in the latter part of the sputtering system for electrode formation, and resist exposure and a developer, or a resist airline printer is installed in the preceding paragraph of the sputtering system for electrode formation. Especially the thing for which the resist airline printer which does not use a photolithography processes is used raises the throughput of TFT manufacture substantially.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the example of the manufacture approach of the gate electrode by this invention.

[Drawing 2] It is drawing showing the example of the manufacture approach of the pixel electrode by this invention.

[Drawing 3] It is drawing showing the example of the manufacture approach of the drain / source electrode by this invention.

[Drawing 4] They are some block diagrams of the TFT-LCD production line by this invention.

[Drawing 5] It is production process drawing of the conventional TFT.

[Description of Notations]

aluminum [ -- Indium Tin oxide (transparence electric conduction film) Cr / -- Chromium. ] --  
Aluminum, SiN -- A silicon nitride film, a-Si -- An amorphous silicon, ITO

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[Translation done.]

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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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PRIOR ART

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[Description of the Prior Art] Conventionally, about the manufacture approach of TFT-LCD (Thin Film Transistor-Liquid Crystal Display), the manufacture approach of LSI and the same technique are used as described the volume Nikkei electronics and on Nikkei micro device, and "flat-panel display'91", for example. Drawing 5 shows the production process of the conventional TFT.

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[Translation done.]



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EFFECT OF THE INVENTION

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[Effect of the Invention] Since patterning of the electrode material formed with a sputtering system is carried out by the lift-off method according to this invention so that clearly from the above explanation, a metaled etching process is lost and a photoresist is not exposed to a metaled etching reagent, exfoliation of a photoresist becomes easy. By the above, since the number of production processes of TFT is shortened, TFT-LCD of low cost and high-reliability can be offered.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] The above-mentioned conventional technique had the following troubles.

[0004] That is, by the above-mentioned manufacture approach, the metaled count of etching is [ the count of etching of the semi-conductor film and an insulator layer ] needed 5 times 3 times, and a production process becomes long. Moreover, since clearance of the photoresist after etching becomes comparatively difficult, a throughput becomes low.

[0005] The object of this invention is solving the trouble stated above and offering TFT-LCD of low cost and high-reliability.

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MEANS

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[Means for Solving the Problem] In order to solve the aforementioned trouble, the manufacture approach of TFT-LCD which has the process which deposits the electrode material which forms this invention with a sputtering system on the glass substrate with which the resist of a reversal mask is formed, and carries out patterning by the lift-off method after that is proposed.

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[Translation done.]

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**OPERATION**

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[Function] By the above-mentioned manufacture approach, since a metaled etching process is lost, the part and the production process of TFT become short. Moreover, in order to carry out patterning of the electrode by the lift-off method, a photoresist is not exposed to a metaled etching reagent. Therefore, exfoliation of a photoresist becomes easy. Therefore, TFT-LCD of low cost and high-reliability can be offered.

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[Translation done.]

